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(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Per HAMBERG et al.

Application No.: NEW   Confirmation No.: N/A

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For: METHOD FOR OPERATING A DATA   Examiner: Not Yet Assigned
      STORAGE APPARATUS EMPLOYING
      PASSIVE MATRIX ADDRESSING

LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The PTO is requested to use the amended sheets/claims attached hereto (which correspond to Article 19 amendments or to claims attached to the International Preliminary Examination Report (Article 34)) during prosecution of the above-identified national phase PCT application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §1.16 or 1.14; particularly, extension of time fees.

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Application No.: NEW

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Respectfully submitted,

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Attachment(s)

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CLAIMS

1.   A method for reducing detrimental phenomena related to disturb
voltages in a data storage apparatus employing passive matrix-addressing,
particularly a memory device or a sensor device, wherein the data storage
5   apparatus comprises a plurality of data storage cells for storing logical values
as given by a specific charge value set in each cell, wherein each of the data
storage cells comprises an electrically polarizable memory material
exhibiting hysteresis, particularly a ferroelectric or electret material, wherein
the cells are physically disposed in one or more matrices, wherein each of
10   said matrices providing passive matrix addressability to the cells, wherein
each of the matrices comprising a first and a second electrode set, wherein
the electrodes of each set are provided in parallel, one set of electrodes
forming word lines and the other set forming bit lines, wherein the word line
electrodes and the bit line electrodes are provided crossing each other and in
15   direct or indirect contact with the memory material, wherein the data storage
cells of the apparatus are realized as capacitor-like elements defined in a
volume of the memory material between or at the crossings of word lines and
bit lines and can be set to either of at least two polarization states or switched
therebetween by applying an active voltage pulse of a voltage V_S larger than
20   the coercive voltage V_C corresponding to the coercive electric field of the
memory material, between a word line and a bit line and over the data storage
cell defined therebetween, wherein an application of electric potentials
conforms to an addressing operation, and wherein the electric potentials
applied to all word and bit lines in the addressing operation are controlled in
25   a time-coordinated manner according to a predetermined voltage pulse
protocol,
characterized by wherein the data storage cells of the data storage apparatus
are provided in two or more electrically separated segments, each segment
comprising a separate physical address space of the data storage apparatus,
30   wherein a first addressing operation comprises setting an one or more
addressed data storage cell cells in one of the segments to a first polarization
state by means of a first active voltage pulse in the addressing operation,
during which each bit line dependent on the voltage pulse protocol can be
connected with a sensing means for detecting the polarization state of the
35   data storage cell at least under a part of the duration of the first active
voltage pulse; applying dependent on the voltage pulse protocol a second
voltage pulse, which can be a second active voltage pulse of opposite polarity

to that of the first active voltage pulse and switching the addressed data storage cell from the first polarization state to a second polarization state, such that the cell being addressed is set to a predetermined polarization state as specified by the addressing operation, ~~providing the data storage cells of the data storage apparatus employing passive matrix addressing in two or more electrically separated segments, each segment comprising a separate physical address space of the data storage apparatus; and directing data in the addressing operation to a segment that is selected based on information on prior and/or scheduled applications of active voltage pulses in the segments.~~, characterized by further applying in the second addressing operation the second voltage pulse to one or more data storage cells in another segment, such that the cell or cells are preset to either the first polarization state or the second polarization state; and dependent on the addressing operation to be carried out, storing information in said one of more preset data storage cells in the other segment after an active voltage pulse with the same polarity has been applied thereto; said another segment being selected for the second addressing operation on the basis of prior and/or scheduled application of active voltage pulses to said two or more electrically separated segments.

~~2. A method according to claim 1, characterized by applying the second voltage pulse to another cell than that subjected to the first active pulse, whereby all cells at the physical address of the other cell are pre-set to either the first polarization state or to the second polarization state and are located in a segment different than that subjected to the first active voltage pulse.~~

~~3. A method according to claim 1, characterized by explicitly storing information on cells at a certain address and which are pre-set to a polarization state after an active voltage pulse of same polarity has been applied to each cell at the address.~~

4~~3~~2. A method according to claim 3~~1~~, characterized by storing information on the pre-set polarization state with reference to the physical address of the cell.

53. A method according to claim 31,
characterized by retrieving the stored information on the polarization state
prior to subjecting a cell to the second voltage pulse.

64. A method according to claim 53,
characterized by applying the optional second active voltage pulse with
opposite polarity to the first active voltage pulse if the pre-set polarization
corresponds to the first polarization state, and applying the optional second
active voltage pulse with same polarity as the first active voltage pulse if the
pre-set polarization corresponds to the second polarization state.

75. A method according to claim 31,
characterized by removing the stored information on the cell being pre-set to
a polarization state after subjecting each of the pre-set cells at the address to
the second voltage pulse.

86. A method according to claim 31,
characterized by storing information on the total number of pre-set cells.

97. A method according to claim 1,
characterized by directing data in an addressing operation to the segment
with the longest time since last being subjected to an active voltage pulse.

108. A method according to claim 97,
characterized by using a queue; putting a reference to the segment most
recently subjected to an active voltage pulse last in the queue and retrieving a
reference to the segment with the longest time since being subjected to an
active pulse from first position in the queue.

119. A method according to claim 910,
characterized by storing references to each of the segments in a "segment
table" with additional information connected to each of the references.

1210. A method according to claim 119,
characterized by the additional information being number of addresses with
pre-set cells in the referenced segment and/or timestamp of last segment
access and/or lock state mark and/or physical addresses to pre-set cells in the
referenced segment and/or a pre-set polarization state mark connected to each
of the physical addresses to pre-set cells.

11. A method according to claim 10,
characterized by removing the physical address of the cell subjected to the
second voltage pulse from the segment table.

12. A method according to claim 10,
characterized by adding the physical address of the cell subjected to the first
active voltage pulse to the segment table.

13. A method according to claim 10,
characterized by setting the lock state mark of a segment reference in the
segment table when the first active voltage pulse or the second voltage is
applied to a cell in the segment corresponding to the segment reference.

14. A method according to claim 10,
characterized by updating the timestamp of last segment access of a segment
reference in the segment table when the first active voltage pulse or the
second voltage pulse is applied to a cell in the segment corresponding to the
segment reference.

15. A method according to claim 10,
characterized by unsetting the lock state mark of a segment reference in the
segment table when the difference between current time and the timestamp of
last segment access for the segment reference exceeds a predetermined
value.

16.   A method according to claim 10,
characterized by waiting to apply the first active voltage pulse until the lock
state mark of the segment to be subjected to the first active voltage pulse has
been unset, and/or waiting to apply the second voltage pulse until the lock
state mark of the segment to be subjected to the second voltage pulse has
been unset

17. A method according to claim 1,
characterized by storing the physical address of the cell subjected to the
second voltage pulse with reference to the logical address of the addressing
operation.

18. A method according to claim 17,
characterized by storing the physical address with reference to the logical
address in an "address mapping table" with optional address level

information connected to each of the physical address entries in the address mapping table.

~~20~~19. A method according to claim ~~19~~18, characterized by the address level information being a pre-set mark and/or a pre-set polarization state mark and/or a segment reference.

~~21~~20. A method according to claim ~~19~~18, characterized by storing the address mapping table in a fast access memory other than the data storage apparatus employing passive matrix-addressing.

~~22~~21. A method according to claim ~~19~~18, characterized by not listing a predetermined number of addresses to pre-set cells in the address mapping table.

~~23~~22. A method according to claim ~~19~~18, characterized by retrieving the physical address with the address level information from the address mapping table before applying the first active voltage pulse and/or the second voltage pulse.

~~24~~23. A method according to claim ~~23~~22, characterized by not applying the first active voltage pulse and bringing the second voltage pulse forward in time if finding a set pre-set mark.

~~25~~24. A method according to claim ~~23~~22, characterized by not applying the first active voltage pulse and bringing the second voltage pulse forward in time if the addressing operation is write and if the address of the pre-set cells is listed in the address mapping table.

~~26~~25. A method according to claim ~~23~~22, characterized by not applying the first active voltage pulse and bringing the second voltage pulse forward in time if the addressing operation is write and if the total number of pre-set cell addresses are exceeding a predetermined value.

~~27~~26. A method according to claim ~~18~~17, characterized by storing the logical address in part of the data storage cells at the physical address corresponding to the logical address.

~~28~~27. A method according to claim 1, characterized by distributing addresses whereat each cell are pre-set to the

same polarization state among the segments during idle time when no other higher-priority operations are ongoing or imminent in the segments.

2928. A method according to claim 2827, characterized by executing a read with write-back operation in the segment with the least number of pre-set cells.

3029. A method according to claim 1, characterized by creating cells that are pre-set to the same polarization state at a free address during idle time when no other higher-priority operations are ongoing or imminent in the segments.

3130. A method according to claim 3029, characterized by applying a single polarity active voltage pulse to each cell at the address.

3231. A method according to claim 3029, characterized by selecting the address in the segment with the least number of pre-set cells

3332. A method according to claim 1, characterized by imposing a delay before applying the first active voltage pulse if the second voltage pulse of the preceding operation, or any of a predetermined number of preceding operations, was applied to the same segment as the current addressing operation.

3433. A method according to claim 1, characterized by imposing a delay before applying the first active voltage pulse if the difference between current time and the last time the segment was subjected to a first active voltage pulse or a second voltage pulse does not exceed a predetermined value.

3534. A method according to claim 1, characterized by imposing a delay before applying the second active voltage pulse if the difference between current time and the last time the segment was subjected to a first active voltage pulse or a second voltage pulse, does not exceed a predetermined value.

36. A method according to claim 12, characterized by waiting to apply the first active voltage pulse until the lock state mark of the segment to be subjected to the first active voltage pulse has

~~been unset, and/or waiting to apply the second voltage pulse until the lock state mark of the segment to be subjected to the second voltage pulse has been unset.~~

3~~7~~35. A method according to claim 1,
characterized by analyzing the consecutive operation or a predetermined number of consecutive operations before executing the current addressing operation.

3~~8~~36. A method according to claim 3~~7~~35,
characterized by selecting another segment than addressed by the consecutive operation or by a predetermined amount consecutive operations for application of the second voltage pulse of the current addressing operation.

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